IGE

NEWSLETTER 2

from

The Institute of Genetic Ecology

Contents:

1990

TOHOKU UNIVERSITY

ROLE OF BIOCIDES IN TURKISH AGRICULTURE

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Turkey with a total area of 781,000 km^2 stands at the crossroads of Europe, where East meets West. It is ranked twentieth in the world in terms of its population size, which has more than doubled in the last 30 years from 20 million 55 million. However, it is one of the few countries in the world with a self sufficiency in food. The reason for this is that, due to diverse ecological areas most of the temperate and sub-tropical foods are being produced in Turkey. Out of the total land area of 78 million hectares, 28 million are used for the production of agricultural crops. The narrow coastal areas are most productive and permit the growth of a variety of crops. As such, inspite of an outburst in the population, with an annual rate of 2.5%, agricultural output has increased at an annual rate of about 3% during the same period. This point to the fact, the performance of the agricultural sector in Turkey has been respectable, which is a testament to its natural advantage as an agricultural producer.

Great efforts are being spent on the possibilities to increase the production by using fertilizers, biocides and farm machinery. During the last 30 years, out of the above given 3 major-inputs in the agricultural production, the fertilizers top the list followed by biocides and farm machinery. Although the use of fertilizers has increased 50 times, use of biocides and machinery has increased 6 and 4 times respectively, which depicts an annual developmental rate of about 22% of fertilizers, 10% for biocides and 7% for the farm machinery. If the biocides are not used the losses in our annual plant production of about 1.5 billion dollars are expected. As such the use of biocides is coming in vogue more and more.

TRENDS IN BIOCIDE PRODUCTION IN TURKEY

A perusal of the history of plant protection in Turkey reveals that, first records come from the year 1873, when a law was passed against the damage caused by the insect Filoksera. An organization was set up to control this damage, but it was not much active till the end of first world war. After the war German advisors were invited to support the said organization. They gave an impetus and quite a bit of work was done in this connection.

The real agrochemical production in Turkey, however, started in 1951 and increased much till 1960. Today more than 70% of the chemicals are produced locally and about 30% are purchased from foreign countries. The firms still are dependent technologically and they produce 36 tons per year, which comes to 9 million dollars, however 37 million dollars are spent for importing about 27 tons of chemicals and 15 million dollars for the import of raw materials per year. This includes insecticides (36%), fungicides (52%), herbicides (8%) and others (6%). All these have showed an increase in their percentage use from 1976 onwards (Table 1). The increase in the number of permitted preparations has been as follows: 1959-1961 (61), 1962-1964 (163), 1965-1967 (172), 1968-1970 (99), 1971-1973 (129), 1974-1976 (144), 1977-1979 (206), 1980-1982 (206), and 1983-1985 (259).

The latest report of the ministry of agriculture depicts that 770 preparations with 220 active ingredients are being sold in Turkey. During this time the production of DDT, BHC and some mercury products has been prohibited.

Table 1: Percentage of Biocides Consumed in Turkey According to Their Active Ingredient Groups

Group / Year	1976	1978	1980	1982	1984
Insecticides	53.47	41.69	33.62	26.69	19.75
Fungicides	35.46	44.72	56.16	62.37	18.50
Herbicides	7.65	8.16	5.92	6.90	6.62
Others	3.38	5.33	4.27	3.69	5.13

A view of cotton plantation in Aegean Region of Turkey (photographed by Dr. Kakizaki)

USE OF BIOCIDES

The biocides used in Turkey are first tested at the agricultural experimental stations, if a biocide proves effective its use is permitted, if not it is prohibited. Generally, the firms producing these chemicals suggest higher doses. For example, if the dose given for some weeds is 200 kg per 100 kg of seeds, it is found to be affective even at the rate of 150 kg per 100 kg of seeds. In the case of cotton the dose suggested was 10 kg of pentochloronitrobenzene per 100 kg of seeds, however, the tests carried out at the experimental station proved that, only 2 kg of this compound are enough to show its affects. This means a saving of at least 2,000 kg of biocides. If a compound is produced by more than one firm then the doses suggested on competitive bases are more realistic. Out of the biocides used in Turkey, the use of insecticides has decreased but that of fungicides has increased (Table 2). On an average bases about 8 kg/hectare of chemicals are being used only in the Aegean and Mediterranean regions of Turkey on 5,784,976 hectares of agricultural land. Out of these cotton plantations in Cukurova region get 32 kg/hectare and vineyards in Aegean region 127 kg/hectare. A comparison of this date with that used in Japan (5,811 g/ha), Switzerland (5,146 g/ha), America (3,514 g/ha), Germany (2,546 g/ha) and Poland (747 g/ha) shows that, Turkey is using extremely high quantities of biocides. The relations between the productivity and biocide use in cotton and grapes in Aegean and Mediterranean regions are given in Table 3. The results given in Table 3 clearly show that, a very poor correlation exists between the production and biocides from the economical point of view.

Table 2: Use of Biocides in Turkey (on the Basis of 100 Percent Ingredients)

Biocides \ Year	1978	1980	1982	1984
Insecticides	5,501	3,214	1,930	2,427
Agaricides	89	291	416	337
Funigants	68	195	43	35
Nematicides	12	111	114	–
Molluscicides	5	2	7	–
Fungicides	1,240	1,330	1,141	1,612
Herbicides	2,993	2,466	1,981	2,019

Table 3: Average Productivity in Cotton and Grapes in Relation to Use of Biocides in Mediterranean and Aegean Regions (Mean of years covering a period from 1980 to 1985)

Region	Productivity (kg/ha)		Biocide (kg/ha)	
	Cotton	Grapes	Cotton	Grapes
Mediterranean	770.39	4,096.55	18.58	38.36
Aegean	851.52	6,840.75	3.72	77.37

PROBLEMS CREATED BY BIOCIDE USE

The problems created by the use of biocides are mainly of two types. They effect human health on one side and cause environmental pollution on the other side. The effects on the human being starts with the labourers producing it and continue up to the consumers i.e. the farmers using it. In certain cases they can pass on to the persons using the farmer's products. Thus the whole population gets a share from it. Many cases of toxicity have been reported untill now due to biocide use. In 1978 out of a total of 946 toxicity cases reported, 79 are said to have died immediately. One of the main reasons for this is a low level of literacy among the biocide dealers. Because out of a total of 707 dealers in 6 main states in Mediterranean region only 4.7% have got primary school education and 2.6% each middle and high school education, 2.1% agricultural education and others cover a percentage of 1.9. The same is the case with the farmers too who use these chemicals with a preliminary knowledge. To this illiteracy of two sides we can add the firms as well, because they try to avoid the use of warning notices exactly and to the point.

As regards the problems of environmental pollution, we come across the cases in different regions of Turkey, in particular mediterranean, where biocides are used at a large scale. In the well waters of Cukurova area residues of lindane (0.1 ppm), heptachlor, aldrin (0.8-1.2 ppm) and dieldrin (0.9-2.0 ppm) have been reported. In the fishes collected from the same area residues of insecticides from the organic chlor group have been detected at a level of 0.339 and 21.650 ppm on fresh weight and oil rate bases. On the Black Sea coast, the investigations undertaken in the state of Trabzon has revealed the residues of chlorinated hydrocarbons as follows:

DDT Products	0.281 ppm
Total BHC	0.074 ppm
Dieldrin	0.052 ppm
Aldrin	0.013 ppm
Endrin	0.008 ppm

In the fish oil from Trabzon the levels of DDT determined have been 26.558 ppm, aldrin 0.1 ppm, endrin 4.703 ppm, BHC 4.171 ppm and dieldrin 2.120 ppm.

In Ankara the studies carried out on the milk products collected from the market has shown that, the insecticidal residue on the internal fat bases was 3.714 ppm, in butter 3.752 ppm, in cheese 1.057 ppm and in milk 0.132 ppm.

The birds also are getting a good share from the biocide applications in Turkey. The aldrin and heptachlor used for seed dressing have caused a great damage to the bird populations in Middle Anatolia and Izmir. In particular the decrease in the population of bald bird found in Birecik to the level of extinction is accepted to be due to the use of biocides.

CONCLUSION

Most of the pest species in natural ecosystems try to maintain their populations at a level not dangerous for the humans on healthwise as well as economical bases. Very few species in fact cause such a damage. As such, if we see a pest it does not mean that we should start control meauseres immediately. The use of biocides has clearly shown that, it results in the problems of residue and resistance leading to a risk for the humans and other organisms. We cannot accept the statement that, biocides are the only remedy, the alternatives are available and should be followed. These mainly are, cultural control where environment of the crops needs to be manipulated in such a way that it is favorable for the so called pest, crop rotation mixed croping, fallowing, good timing of planting and harvesting, good but strict quarantine rules, autocidal controls where organism can be used instead of chemicals, genetic manipulations, repellents, attractans, antimetabolites, growth regulators and biological control on ecological bases. Inspite of all this it is rather difficult to convince a farmer who sees insects in his field, that there is no need to use the chemicals. So it would be unwise to advocate a complete ban on the biocides without having proper alternatives ready for the use of farmers. However, the use could be made only if the population of a so called pest goes beyond a level causing an economic loss to the farmer. The other but most important point in this connection would be that, the rate of literacy among the farmers in Turkey as well as other developing countries need be raised to a higher level that will make things easier for the farmer and the biocide producer as well as the ecosystems.

(Assoc. Prof. of Ege University, Izmir, Turkey)

FROM A GHANAIAN RESEARCH STUDENT AT IGE

Michael K. Menyah

Viewed from agricultural standpoint the Ghanaian environment like others in the tropics presents an ecological setting that gives researchers enough to contend with in terms of working towards sustained production of useful plant species.

By virtue of its location, it receives abundant sunshine with the predominance of fairly high average daily temperatures, the annual mean usually not below 25℃ and a range of about 24℃-36℃. Rainfall is restricted to some few months during the year with a range of about 190 cm-150 cm per annum for the forest regions and 110 cm-57 cm for the savanna areas. The rainfall regime — its distribution throughout the year — though varying greatly reveals mainly two peaks. The major raining season extending from March/April to July and the minor September to November. This trend is by no means static with much irregularities which sometimes terribly worsens the plight of small scale farmers.

Though a large variety of plant species are apparently adapted to some of the 'harsh' features of the natural environment, here lies the irony; while sunshine abounds facilitating photosynthetic processes, with fairly high temperatures that promote accompanying biochemical processes, these apparently useful parameters of the environment on one hand contribute to rapid depletion of much needed water from the soil-plant system. Useful agricultural crops and other plant species must therefore contend with the fairly high temperatures and inadequacies in moisture for long periods. The activities of indigenous small scale farmers who mostly depend on rainfall are thus greatly limited thereby.

In the light of the above researchers in Ghana, laden with the responsibility of finding ways to maximise benefits from the wide variety of plant genetic resources have had to live up to the task of selecting those species which among other things can survive the stresses of the natural enivironment with satisfactory yields. Breeders have to some extent lived up to this task with some successes in selecting indigenous species with best combination of desirable characteristics and also incorporating desirable traits from exotic species into local varieties. Agronomist have worked towards evolving integral stable cropping systems well suited to the farmers' situation with less distructive ecological effects. The soil being a component of both the forest and savanna ecosystems is obviously subject to the prevailing environmental conditions. The use of chemicals becoming more common even among small scale farmers, the soil directly or indirectly serves as a receptable for reasonable amounts of agricultural chemicals which have the potential of influencing soil processes to appreciable extend rendering the conditions in the soil ecosystem more complex. Soil scientist back home in Ghana have thus worked towards uncovering the processes to which the components of the soil (nutrients, water, microbes, soil solids, etc) are subjected during cultivation or otherwise, with the view to finding ways to optimize soil conditions in the farmers' field for sustained crop production. Fertilizer recomendations, appropriate soil management practices etc, suited to local condition, have emerged from these efforts.

The forest and savanna regions of Ghana presents very contrasting ecological features with the forest supporting a denser vegetation and wider variety of plant species dominated by trees and generally providing a more conducive atmosphere for crop production than the savanna regions which are much dryer with sparse vegetation mainly grass. This gives rise to the adoption of different cultivation practices by farmers in the two regions. Hence as one personally interested in the soil environment and microbial ecology, a simple study conducted in 1987 was to assess the microbial biomass status of representative soils from the forest and savanna regions with the view to comparing the effects of cultivation on this component of the soil ecosystem in these two regions. Among others, the result revealed that the equilibrium microbial biomass of the uncultivated forest topsoil was 2.7 times that of the corresponding savanna soil. Secondly, whereas in the forest adjacent cultivated plots showed 37% decrease in the microbial biomass that in the savanna soil was as much as 52%. Suggesting that cultivation as envisaged does have detrimental effect on the soil microbial biomass, the forest apparently providing an environment that better cushions the effect of cultivation on the soil microbial biomass. Ironically, however, the use of heavy machinery for farming, which has potentially destructive effect on the soil environment, is more predominant in the savanna regions of Ghana.

A proverb in Ghana literally goes like this "One uses fish (bait) to catch fish". Meaning that one needs to invest in order to reap some profit. This in my view adequately underscores the differences between research here at IGE and Ghana. Being a developing country, the general limitation of foreign exchange has had its toll on research in Ghana. While researchers try to do their best, progress is greatly hampered by lack of some essential equipment and irregularities in general laboratory supplies obviously due to the almighty problem of the developing world 'foreign exchange' for imports. This apparently does not exist here where one can pick a phone and get the requisite supplies in practically no time. Whereas one can pursue long term research here with virtually no limitation in terms of material support, back home such studies may in one way or the other be limited along the line. In depth study on one research issue is thus greatly hampered.

Though I have not been here for long, I can fairly well state that the IGE setting does provide a good framework within which to conduct research. With the supply of all laboratory materials readily available, the requisite scientific equipment and other facilities in place one can literally say that 'the sky is indeed the limit' to what one can do. This is further strengthened by the presence of researchers from different fields providing an opportunity for exchange of ideas and collective approach to solving research problems. With the current goal of promoting cooperation with outside scientist I consider the opportunity to work in IGE a good and challenging one in which one can give off his best, even so I hope to do, with the believe that others from the developing world like Ghana will also be given such opportunity.

(University of Ghana-Legon)

Letter to the Editor: Structural Aspect of Soil Microhabitat —A basic concept in soil microbiology—

Tsutomu Hattori

In soil a variety of microorganisms is living and their lives are affected largely by chemical and physicochemical factors of microhabitat of soil.

One of the essential characteristics of the soil microhabitat is its discreteness which originates from the structure composed of organic debris, soil particles and their aggregates of varying size. The aggregate structure produces two kinds of differentiation in space occupation. One is the differentiation into "smaller pores" (SP; less than 2.5-3.0 μm in the diameter of the pore neck) and "larger pores" (LP; larger than 2.5-3.0 μm in the pore neck diameter). The other is the "outer region" (OR) and "inner region" (IR) divisions of soil aggregates. Here OR involves interaggregate space. Until recently I had only used the terms "outer part" and "inner part" of soil aggregates. However the outer part ($\fallingdotseq$OR) may contain both the SP and the LP (Darbyshire *et al.*, 1989). While bacteria, protozoa or fungi in the IR survive rather quietly (in a dormant state), those organisms in the OR experience drastic population changes through proliferation, competition, antagonism, predation and so on. The water retention and the partial pressure of oxygen in the region are key factors for controlling these microbial actions.

Here I shall make note of some facts which should help in our further understanding. (1) Microbial flora in the IR is largely affected by the process of aggregate formation: Microbial cells hardly enter the IR after aggregate formation.

(2) Soil aggregates are eventually decomposed by biotic and abiotic agents. It is important to examine the half-life of these aggregates. (3) Bacterial cells in soil do not necessarily initiate proliferation immediately after receiving a food supply, but do so according to the first order reaction kinetics. The rate decreases as bacterial cells starve. We can obtain information on the bacterial state from the colony counting data of soil bacteria (Hattori, 1988). (4) Organic substances and bacterial or protozoan cells which are exogeneously supplied can be largely distribute in the OR and partly in the IR, owing to narrow channels found between pores, or to the absence of channels altogether. Hence they are vulnerable to the attack by other organisms. They can defend themselves from this attack, however, by adhering to clay particles.

In any case I hope this concept serves its purpose in combining different disciplines of soil biology and biochemistry.

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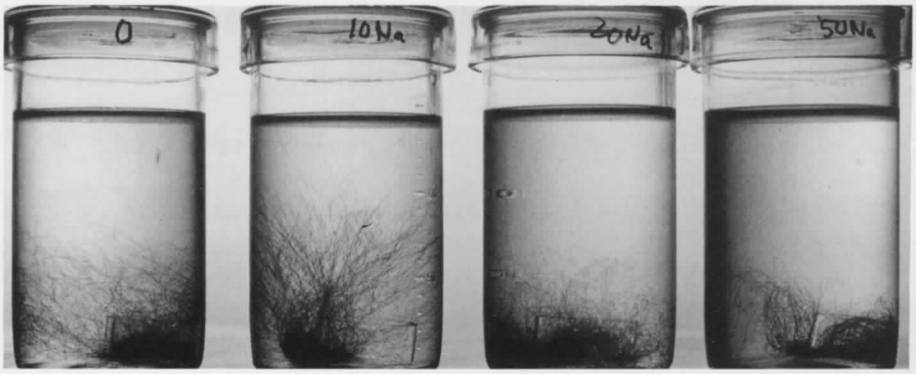
(Prof. of IGE)

Profiles of Experimental Materials : *Vaucheria*

Vaucheria litorea

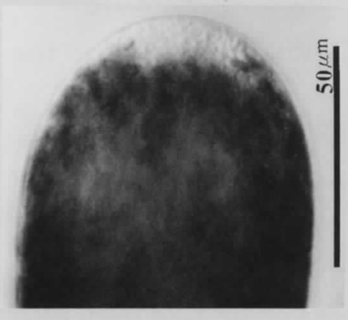
In the Division of Ecological Physiology of the IGE different strains of siphonaceous coenocytic alga *Vaucheria* De Candole have been used for experimental materials. *Vaucheria's* first report was about 270 years ago by Rajus (1724) and the definitive taxonomic position is still in hot and controversial discussion. Before 1971 *Vaucheria* belonged to the Chlorophyceae, when chlorophyll c was found. Since then they have been an own order within the Xanthophyceae (Vaucheriaceae), because of some untypical morphological and physiological characteristics, e.g., spermatozoids are similar to those of brown algae (Phaeophyceae), and presence of unique synzoospores.

The species of *Vaucheria* are world wide distributed in the eu-and sublittoral of fresh-, brackish- and sea water, and it is also found on mud. Many species are very tolerant to NaCl and are able to survive in a wide range of salinities (0.8-60 ‰). Morphologically different races are known and they also differ in their preference for habitats. Therefore portrayal



NaCl-induced negative phototropism in *Vaucheria terrestris*.

Oogonium of
Vaucheria dichotoma



Growing apex of
Vaucheria terrestris

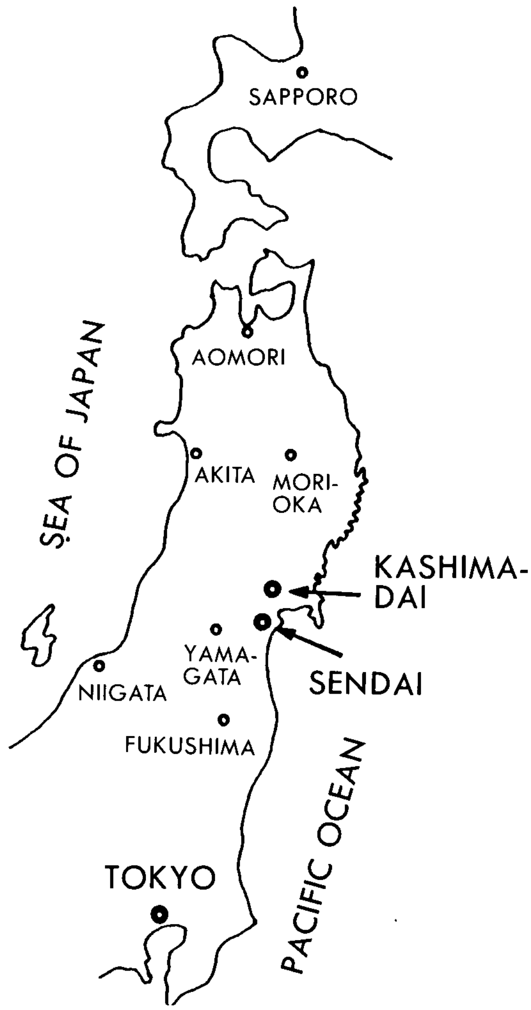
of the habitat is recommended. The occurrence of ecotypes is in discussion, although the proof is still lacking: the thallus diameter varies with salinity, the phototropic response may also change with increasing salinity.

The ecological importance of the alga based on the high productivity, especially in shallow coastal regions, and seems to play an important role in the self-cleaning capacity of water. Furthermore, the alga grows in dense benthic meadows down till 15 m depth, which is important for sedimentation, and in huge floating mats on the surface of water.

The phototropic response of *V. geminata* and *V. terrestris* have been analyzed in detail here in this Institute since 1976 (by H. Kataoka). The phototropic inversion from positive to negative direction occurs when the light intensity exceeds a certain level, and this inversion was recently found to be regulated by blue-light-dependent Ca^{2+} influx at the apex. High salinity also causes the phototropic inversion. No such inversion was found in other algae nor in higher plants, although it seems to be common escaping phenomenon from strong sunlight.

For review: see Rieth, A. (1980) Süsswasserflora von Europa, Xanthophyceae, 4-2, eds. Ettl, H. *et al.*, Gustav Fischer-Verlag, Stuttgart, New York.

(By H. Kataoka, Institute of Genetic Ecology, and D. Henschel, University of Bremen, Marine Botany, F. R. G.)



The main laboratory of the IGE is in Katahira area of Sendai, located about 350 kilometers north of central Tokyo. The farm research station is in a small town, Kashimadai, located about 38 kilometers further north of the Sendai laboratory.

(Color Picture : Cover)
The Institute of Genetic Ecology (IGE) of Tohoku University and the garden under the sunlight in spring. The tree with scarlet-tinged leaves is the maple tree *Acer palmatum*.
(Photographed by Keizo Abe,
Head Official of IGE)

Errata in
Newsletter 1

P14 康鎮城→庚鎮城
季汝琪→李汝琪
P2-3 Assist. Prof.→Res. Assoc.
Res. Assoc.→Res. Assist.

Published by
The Institute of Genetic Ecology,
Tohoku University, Katahira,
Aoba-ku, Sendai, Japan 980
Telephone : 022-227-6200